Lattice

GAL16V8B/883
GAL16V8A/883

T-46-19-07

High Performance E²CMOS PLD

FEATURES

- **HIGH PERFORMANCE E²CMOS® TECHNOLOGY**
  - **— 10 ns Maximum Propagation Delay**
  - **— Fmax = 62.5 MHz**
  - **— 7 ns Maximum from Clock Input to Data Output**
  - **— TTL Compatible 24 mA Outputs**
  - **— UltraMOS® Advanced CMOS Technology**
- **50% to 75% REDUCTION IN POWER FROM BIPOLAR**
  - **— 75mA Typ Icc on Low Power Device**
  - **— 45mA Typ Icc on Quarter Power Device**
- **ACTIVE PULL-UPS ON ALL PINS (GAL16V8B)**
- **E² CELL TECHNOLOGY**
  - **— Reconfigurable Logic**
  - **— Reprogrammable Cells**
  - **— 100% Tested/Guaranteed 100% Yields**
  - **— High Speed Electrical Erasure (<100ms)**
  - **— 20 Year Data Retention**
- **EIGHT OUTPUT LOGIC MACROCELLS**
  - **— Maximum Flexibility for Complex Logic Designs**
  - **— Programmable Output Polarity**
  - **— Also Emulates 20-pin PAL® Devices with Full Function/Fuse Map/Parametric Compatibility**
- **PRELOAD AND POWER-ON RESET OF ALL REGISTERS**
  - **— 100% Functional Testability**
- **APPLICATIONS INCLUDE:**
  - **— DMA Control**
  - **— State Machine Control**
  - **— High Speed Graphics Processing**
  - **— Standard Logic Speed Upgrade**
- **ELECTRONIC SIGNATURE FOR IDENTIFICATION**

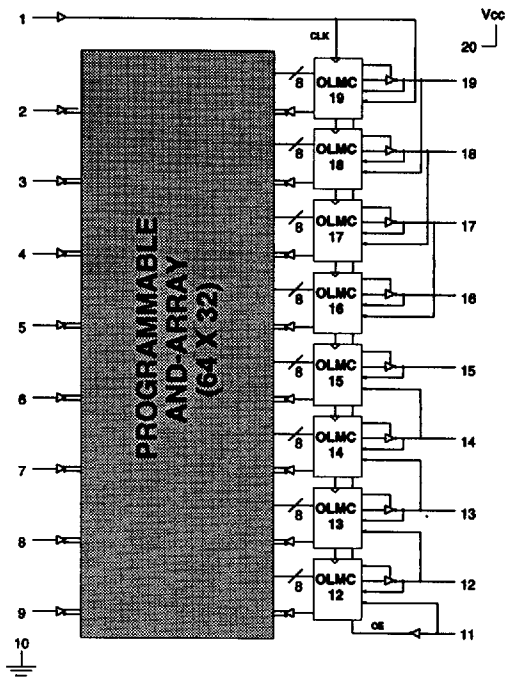
DESCRIPTION

The GAL16V8B/883 and GAL16V8A/883 are high performance E²CMOS programmable logic devices processed in full compliance to MIL-STD-883. These military grade devices combine a high performance CMOS process with Electrically Erasable (E^2) floating gate technology to provide the highest speed/power performance available in the 883 qualified PLD market. The GAL16V8B/883, at 10ns maximum propagation delay time, is the world's fastest military qualified CMOS PLD. CMOS circuitry allows the GAL16V8A quarter power devices to consume just 45mA typical Icc, which represents a 75% savings in power when compared to bipolar counterparts.

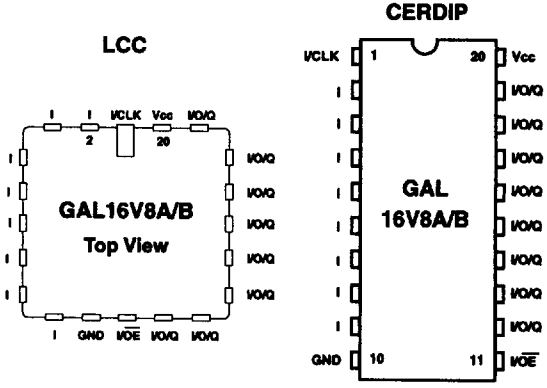
Generic architecture provides maximum design flexibility by allowing the Output Logic Macrocell (OLMC) to be configured by the user. The GAL16V8A/883 and GAL16V8B/883 are capable of emulating all standard 20-pin PAL® devices with full function/fuse map/parametric compatibility.

Unique test circuitry and reprogrammable cells allow complete AC, DC, and functional testing during manufacture. Therefore, Lattice guarantees 100% field programmability and functionality of all GAL products. Lattice also guarantees 100 erase/rewrite cycles and that data retention exceeds 20 years.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



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May 1992

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Specifications *GAL16V8B/883*

ABSOLUTE MAXIMUM RATINGS(1)

Supply voltage V_{CC} .....–0.5 to +7V
Input voltage applied .....–2.5 to V_{CC} +1.0V
Off-state output voltage applied .....–2.5 to V_{CC} +1.0V
Storage Temperature .....–65 to 150°C
Case Temperature with
Power Applied .....–55 to 125°C

1. Stresses above those listed under the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress only ratings and functional operation of the device at these or at any other conditions above those indicated in the operational sections of this specification is not implied (while programming, follow the programming specifications).

RECOMMENDED OPERATING COND.

Case Temperature (T_C) .....–55 to 125°C
Supply voltage (V_{CC})
with Respect to Ground .....+4.50 to +5.50V

DC ELECTRICAL CHARACTERISTICS

Over Recommended Operating Conditions (Unless Otherwise Specified)

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.[3]	MAX.	UNITS
V_{IL}	Input Low Voltage		Vss – 0.5	—	0.8	V
V_{IH}	Input High Voltage		2.0	—	Vcc+1	V
I_{IL}[1]	Input or I/O Low Leakage Current	$0V \le V_{IN} \le V_{IL}$ (MAX.)	—	—	–100	µA
I_{IH}	Input or I/O High Leakage Current	$3.5V \le V_{IN} \le V_{CC}$	—	—	10	µA
V_{OL}	Output Low Voltage	I_{OL} = MAX. Vin = V_{IL} or V_{IH}	—	—	0.5	V
V_{OH}	Output High Voltage	I_{OH} = MAX. Vin = V_{IL} or V_{IH}	2.4	—	—	V
I_{OL}	Low Level Output Current		—	—	12	mA
I_{OH}	High Level Output Current		—	—	–2	mA
I_{OS}[2]	Output Short Circuit Current	V_{CC} = 5V V_{OUT} = 0.5V T_A = 25°C	–30	—	–150	mA
I_{CC}	Operating Power Supply Current	V_{IL} = 0.5V V_{IH} = 3.0V f_{toggle} = 25 MHz Outputs Open (no load)	—	75	130	mA

1) The leakage current is due to the internal pull-up on all pins. See Input Buffer section for more information.
2) One output at a time for a maximum duration of one second. Vout = 0.5V was selected to avoid test problems caused by tester ground degradation. Guaranteed but not 100% tested.
3) Typical values are at Vcc = 5V and T_A = 25 °C

CAPACITANCE (T_A = 25 C, f = 1.0 MHz)

SYMBOL	PARAMETER	MAXIMUM*	UNITS	TEST CONDITIONS
C_I	Input Capacitance	10	pF	V_{CC} = 5.0V, V_I = 2.0V
$C_{I/O}$	I/O Capacitance	10	pF	V_{CC} = 5.0V, $V_{I/O}$ = 2.0V

*Guaranteed but not 100% tested.

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Specifications GAL16V8B/883

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AC SWITCHING CHARACTERISTICS

Over Recommended Operating Conditions

PARAMETER	TEST COND[1].	DESCRIPTION	-10		UNITS
			MIN.	MAX.	
tpd	1	Input or I/O to Combinational Output	2	10	ns
tco	1	Clock to Output Delay	1	7	ns
tcf[2]	—	Clock to Feedback Delay	—	7	ns
tsu	—	Setup Time, Input or Feedback before Clock	10	—	ns
th	—	Hold Time, Input or Feedback after Clock	0	—	ns
fmax[3]	1	Maximum Clock Frequency with External Feedback, 1/(tsu + tco)	58.8	—	MHz
	1	Maximum Clock Frequency with Internal Feedback, 1/(tsu + tcf)	58.8	—	MHz
	1	Maximum Clock Frequency with No Feedback	62.5	—	MHz
twh	—	Clock Pulse Duration, High	8	—	ns
twl	—	Clock Pulse Duration, Low	8	—	ns
ten	2	Input or I/O to Output Enabled	—	10	ns
	2	$\overline{OE}$ to Output Enabled	—	10	ns
tdis	3	Input or I/O to Output Disabled	—	10	ns
	3	$\overline{OE}$ to Output Disabled	—	10	ns

1) Refer to **Switching Test Conditions** section.
2) Calculated from fmax with internal feedback. Refer to **fmax Descriptions** section.
3) Refer to **fmax Descriptions** section.

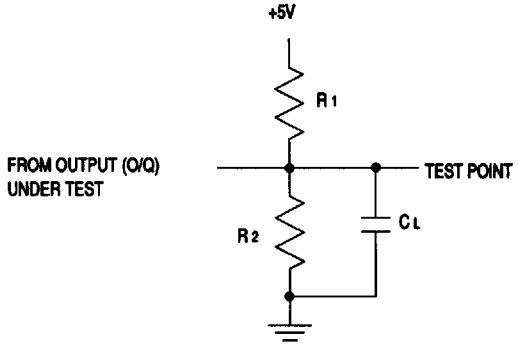
SWITCHING TEST CONDITIONS

Input Pulse Levels	GND to 3.0V
Input Rise and Fall Times	3ns 10% – 90%
Input Timing Reference Levels	1.5V
Output Timing Reference Levels	1.5V
Output Load	See Figure

3-state levels are measured 0.5V from steady-state active level.

Output Load Conditions (see figure)

Test Condition		R1	R2	CL
1		390Ω	750Ω	50pF
2	Active High	∞	750Ω	50pF
	Active Low	390Ω	750Ω	50pF
3	Active High	∞	750Ω	5pF
	Active Low	390Ω	750Ω	5pF



CL INCLUDES JIG AND PROBE TOTAL CAPACITANCE

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Specifications GAL16V8A/883

ABSOLUTE MAXIMUM RATINGS(1)

Supply voltage V_{CC} .....–0.5 to +7V
Input voltage applied .....–2.5 to V_{CC} +1.0V
Off-state output voltage applied .....–2.5 to V_{CC} +1.0V
Storage Temperature .....–65 to 150°C
Case Temperature with
Power Applied .....–55 to 125°C

1. Stresses above those listed under the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress only ratings and functional operation of the device at these or at any other conditions above those indicated in the operational sections of this specification is not implied (while programming, follow the programming specifications).

RECOMMENDED OPERATING COND.

Case Temperature (T_C) .....–55 to 125°C
Supply voltage (V_{CC})
with Respect to Ground .....+4.50 to +5.50V

DC ELECTRICAL CHARACTERISTICS

Over Recommended Operating Conditions (Unless Otherwise Specified)

SYMBOL	PARAMETER	CONDITION		MIN.	TYP.[2]	MAX.	UNITS
V_{IL}	Input Low Voltage			Vss – 0.5	—	0.8	V
V_{IH}	Input High Voltage			2.0	—	Vcc+1	V
I_{IL}	Input or I/O Low Leakage Current	$0V \le V_{IN} \le V_{IL}$ (MAX.)		—	—	-10	µA
I_{IH}	Input or I/O High Leakage Current	$V_{IH} \le V_{IN} \le V_{CC}$		—	—	10	µA
V_{OL}	Output Low Voltage	I_{OL} = MAX. Vin = V_{IL} or V_{IH}		—	—	0.5	V
V_{OH}	Output High Voltage	I_{OH} = MAX. Vin = V_{IL} or V_{IH}		2.4	—	—	V
I_{OL}	Low Level Output Current			—	—	12	mA
I_{OH}	High Level Output Current			—	—	–2.0	mA
I_{OS}[1]	Output Short Circuit Current	V_{CC} = 5V V_{OUT} = 0.5V T_A = 25°C		–30	—	–150	mA
I_{CC}	Operating Power Supply Current	V_{IL} = 0.5V V_{IH} = 3.0V	L -15/-20/-30	—	75	130	mA
		Outputs Open (no load) f_{toggle} = 25MHz	Q -20/-25	—	45	65	mA

1) One output at a time for a maximum duration of one second. Vout = 0.5V was selected to avoid test problems by tester ground degradation. Guaranteed but not 100% tested.
2) Typical values are at Vcc = 5V and T_A = 25 °C

CAPACITANCE (T_A = 25 C, f = 1.0 MHz)

SYMBOL	PARAMETER	MAXIMUM*	UNITS	TEST CONDITIONS
C_I	Input Capacitance	10	pF	V_{CC} = 5.0V, V_I = 2.0V
$C_{I/O}$	I/O Capacitance	10	pF	V_{CC} = 5.0V, $V_{I/O}$ = 2.0V

*Guaranteed but not 100% tested.

AC SWITCHING CHARACTERISTICS

Over Recommended Operating Conditions

PARAMETER	TEST COND[1]	DESCRIPTION	-15		-20		-25		-30		UNITS
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
tpd	1	Input or I/O to Combinational Output	3	15	3	20	3	25	3	30	ns
tco	1	Clock to Output Delay	2	12	2	15	2	15	2	20	ns
tcf[2]	—	Clock to Feedback Delay	—	12	—	15	—	15	—	20	ns
tsu	—	Setup Time, Input or Feedback before Clock	12	—	15	—	20	—	25	—	ns
th	—	Hold Time, Input or Feedback after Clock	0	—	0	—	0	—	0	—	ns
fmax[3]	1	Maximum Clock Frequency with External Feedback, 1/(tsu + tco)	41.6	—	33.3	—	28.5	—	22.2	—	MHz
	1	Maximum Clock Frequency with Internal Feedback, 1/(tsu + tcf)	41.6	—	33.3	—	28.5	—	22.2	—	MHz
	1	Maximum Clock Frequency with No Feedback	50	—	41.6	—	33.3	—	33.3	—	MHz
twh	—	Clock Pulse Duration, High	10	—	12	—	15	—	15	—	ns
twl	—	Clock Pulse Duration, Low	10	—	12	—	15	—	15	—	ns
ten	2	Input or I/O to Output Enabled	—	15	—	20	—	25	—	30	ns
	2	$\overline{OE}$ to Output Enabled	—	15	—	18	—	20	—	25	ns
tdis	3	Input or I/O to Output Disabled	—	15	—	20	—	25	—	30	ns
	3	$\overline{OE}$ to Output Disabled	—	15	—	18	—	20	—	25	ns

1) Refer to **Switching Test Conditions** section.
2) Calculated from fmax with internal feedback. Refer to **fmax Descriptions** section.
3) Refer to **fmax Descriptions** section.

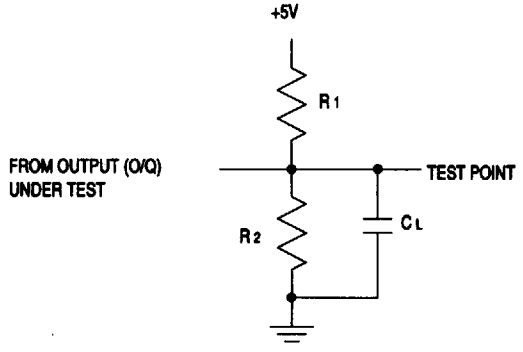
SWITCHING TEST CONDITIONS

Input Pulse Levels	GND to 3.0V
Input Rise and Fall Times	3ns 10% – 90%
Input Timing Reference Levels	1.5V
Output Timing Reference Levels	1.5V
Output Load	See Figure

3-state levels are measured 0.5V from steady-state active level.

Output Load Conditions (see figure)

Test Condition		R1	R2	CL
1		390Ω	750Ω	50pF
2	Active High	∞	750Ω	50pF
	Active Low	390Ω	750Ω	50pF
3	Active High	∞	750Ω	5pF
	Active Low	390Ω	750Ω	5pF



C L INCLUDES JIG AND PROBE TOTAL CAPACITANCE

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Specifications GAL16V8B/883 GAL16V8A/883

SWITCHING WAVEFORMS

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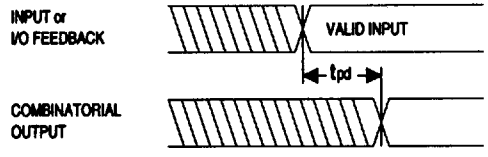
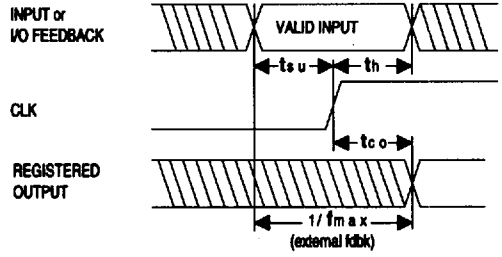
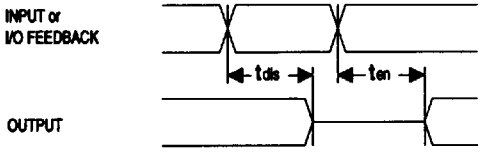


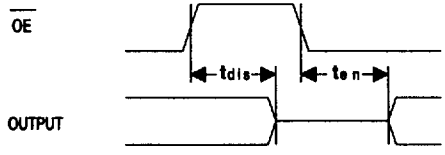
Combinatorial Output



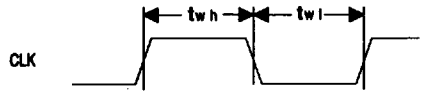
Registered Output



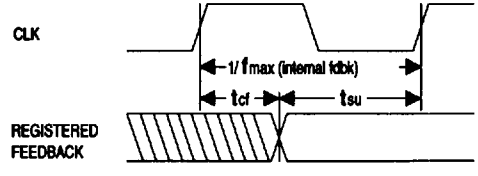
Input or I/O to Output Enable/Disable



$\overline{OE}$ to Output Enable/Disable



Clock Width



fmax with Feedback

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Specifications GAL16V8B/883 GAL16V8A/883

fmax DESCRIPTIONS

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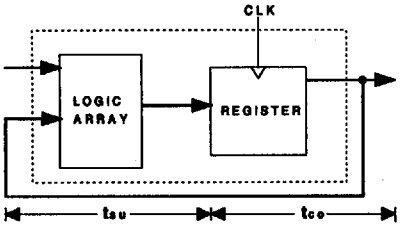
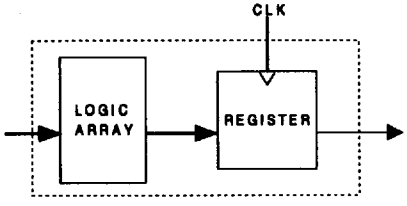


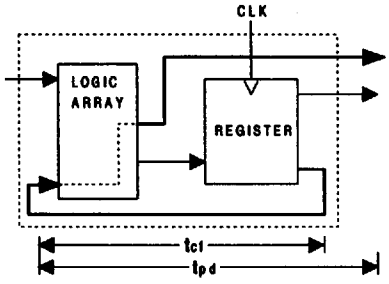
fmax with External Feedback 1/(tsu+tco)

Note: fmax with external feedback is calculated from measured tsu and tco.



fmax Without Feedback

Note: fmax with no feedback may be less than 1/(twh + twl) this is to allow for a clock duty cycle of other than 50%.



fmax with Internal Feedback 1/(tsu+tcf)

Note: tcf is a calculated value, derived by subtracting tsu from the period of fmax w/ internal feedback (tcf = 1/fmax - tsu). The value of tcf is used primarily when calculating the delay from clocking a register to a combinatorial output (through registered feedback), as shown above. For example, the timing from clock to a combinatorial output is equal to tcf + tpd.

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Specifications *GAL16V8B/883 GAL16V8A/883*

GAL16V8A/B ORDERING INFORMATION (MIL-STD-883 and SMD)

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Tpd (ns)	Tsu (ns)	Tco (ns)	Icc (mA)	Package	Ordering # MIL-STD-883	Ordering # SMD #
10	10	7	130	20-Pin CERDIP	GAL16V8B-10LD/883	5962-8983904RA
			130	20-Pin LCC	GAL16V8B-10LR/883	5962-89839042A
15	12	12	130	20-Pin CERDIP	GAL16V8A-15LD/883	5962-8983903RA
			130	20-Pin LCC	GAL16V8A-15LR/883	5962-89839032A
20	15	15	65	20-Pin CERDIP	GAL16V8A-20QD/883	5962-8983906RA
			65	20-Pin LCC	GAL16V8A-20QR/883	5962-89839062A
			130	20-Pin CERDIP	GAL16V8A-20LD/883	5962-8983902RA
			130	20-Pin LCC	GAL16V8A-20LR/883	5962-89839022A
25	20	15	65	20-Pin CERDIP	GAL16V8A-25QD/883	5962-8983905RA
			65	20-Pin LCC	GAL16V8A-25QR/883	5962-89839052A
30	25	20	130	20-Pin CERDIP	GAL16V8A-30LD/883	5962-8983901RA
			130	20-Pin LCC	GAL16V8A-30LR/883	5962-89839012A

Note: Lattice recognizes the trend in military device procurement towards using SMD compliant devices, as such, ordering by this number where it exists is recommended.

PART NUMBER DESCRIPTION